

LOW DIELECTRIC CONSTANT POCKETS IN MULTILAYER CERAMIC MODULES

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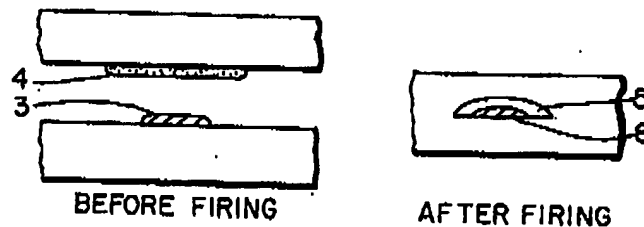


FIG. 1

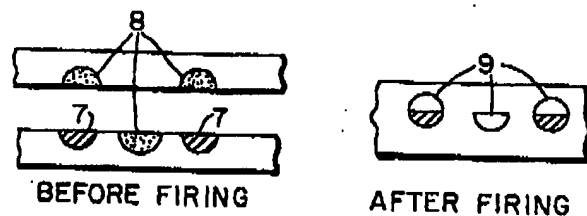


FIG. 2

The insulator between conductors in multilayered ceramic packages for high-speed integrated circuits should have a low dielectric constant (about 2 to 4) in order to meet certain electronic requirements. To lower the effective dielectric constant between conductors, air gaps or pockets of low dielectric material are formed in selected areas between the conductors.

To form such low dielectric areas in a multilayer ceramic module, for example, first a metal paste 3 with metal particles is screen-printed on the ceramic green sheets in the desired patterns, as shown in Fig. 1. On the adjacent surfaces of the next green sheets in the package a mirror image of the pattern is screen-printed, using a filler paste 4 which contains materials which do not volatilize at the laminating temperature, but which volatilize completely at the sintering temperature

of the ceramic module, such as a solution of alpha methyl styrene, organic thickeners, etc. The paste may also contain refractory particles of a low dielectric constant material but no metals or compounds yielding metals during firing. The filler-paste pattern matches the metal-paste pattern except that there is no filler paste on the sites where interconnections are to be made to other levels of the package. The areas of the filler-paste preferably are larger than the metal-paste areas. One filler-paste area may also cover several metal-paste areas. After drying, laminating and firing, an air gap 5 results directly over the top and the edges of the internal conductor 6, reducing the average (effective) dielectric constant of the insulator between conductors.

Alternately, recesses in the desired conductor pattern may be formed in the ceramic green sheet by electron beam cutting, mechanically stamping and similar methods, as shown in Fig. 2. The cut recesses are filled with the metal paste 7 by squeegeeing, etc. Then, other recesses are formed adjacent to the metal-paste-filled recesses 7 on the same ceramic green sheet and/or on the adjacent surface of the next ceramic green sheet, and filled with the filler paste 8. After drying, laminating and firing, air gaps 9 result, as in the Fig. 1 example, to reduce the average dielectric constant of the insulator.

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